USAWC STRATEGY RESEARCH PROJECT

SHORTENING THE DEFENSE ACQUISITION CYCLE:
A TRANSFORMATIONAL IMPERATIVE?

by

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ABSTRACT

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Cycle time reduction has been a defense acquisition problem for more 30 years. It is not a transformational imperative, but it is one piece of a defense reform puzzle that requires closer scrutiny and a genuine fix. The acquisition system is both political and complex. This SRP explores the effectiveness of past policy changes to reduce cycle time and reviews current acquisition issues or problems related to cycle time reduction. A number of concluding recommendations address this problem holistically. It is understandable that the acquisition system is viewed as dysfunctional, but changing the process every four years without fundamentally addressing other key problems and unintended consequences from past policy changes only creates greater dysfunction. The current definition of acquisition cycle time is too restrictive—it measures only SDD development time. A better measure is needed to encompass both the pre-acquisition cycle time (front end) and the production cycle time (back end).   Adoption of evolutionary acquisition as the preferred strategy is a risky step; a number of serious challenges have to be addressed to avoid failure of this new strategy. The acquisition system is not a hopeless system imprisoned by time and complexity. Real opportunities are available to shorten the acquisition cycle time.

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SHORTENING THE DEFENSE ACQUISITION CYCLE: A TRANSFORMATIONAL IMPERATIVE?

In May 2003, the Department of Defense (DOD) instituted new acquisition policies set forth in two directives—DOD Directive 5000.1 (The Defense Acquisition System) and DOD Instruction 5000.2 (The Operation of the Defense Acquisition System).[1] These new acquisition policies represent a major shift from the old "grand design" weapon system approach used during the Cold War. They offer a new, more flexible incremental approach (evolutionary acquisition strategy) as the preferred approach for rapidly acquiring and fielding advanced warfighting capabilities.[2] Despite this change in policy, many critics of the Defense Acquisition System argue that the real acquisition problem is a "cycle time measured in decades." Promoting transformation, Defense Secretary Rumsfeld has made this problem a top DOD priority. He has compared the historical average cycle time, labeled as the current cycle time, to that when he was the Secretary of Defense during the Ford administration (1975-1977): "Cycle time during the 1960s and 1970s was significantly shorter than it is today."[3]

According to VADM (Ret) Arthur Cebrowski, Director of the Force Transformation Office, "[the riddle that must be solved is] why [are] commercial cycle times measured in weeks, months or just a few years, while DOD's cycle time is measured in decades."[4] Reducing the cycle time is a problem older than 30 years.[5] But cycle time reduction is not the key to transformational success; instead, it is only one piece of a puzzle that requires closer scrutiny and longer lasting change. Evolutionary acquisitions are intended to reduce cycle time and speed up fielding new capabilities; however, technical uncertainties and unrealistic expectations could produce different results and longer cycle times, costing even more to field fewer capabilities than originally planned. Such a problematic scenario will raise only more doubt and skepticism regarding a complex system already viewed by many as too monolithic and immune to change.   This SRP will (1) analyze the effectiveness of past policy changes to reduce cycle time, (2) evaluate the current acquisition issues and challenges affecting cycle time reduction, and (3) provide recommendations on how to better accomplish the intended goal of cycle time reduction.

BACKGROUND

ACQUISITION CYCLE TIME

No formal definition of "acquisition cycle time" exists in DOD Directive 5000.1. The generally accepted definition is "the period of time that an acquisition program takes from program start to achievement of the [acquired product's] initial operating capability (IOC)."[6]

Since 1960, the average cycle time has been 132 months.[7] Cycle times can vary considerably: Some programs like the F-22 Raptor and RAH-66 Comanche have longer cycle times that range between 15 – 20 years, while other programs like the Joint Direct Attack Munitions (JDAM) program and the Army's ATACM modification program averaged six years or less in cycle time.[8] The average cycle time swings back and forth like a pendulum, which is a major source of concern and frustration to the warfighter.[9]

REASONS FOR CHANGE

Technology is advancing rapidly; likewise, new and unpredictable threats have been suddenly emerging. Warfighters are demanding faster delivery of new capabilities in order to counter these uncertainties and unpredictable threats. The pace at which we develop weapon systems is too slow to keep up with the pace of technological change. Because of this mismatch, the acquisition process produces "yesterday's capabilities for tomorrow."[10] Critics rightly point out that "systems that require a decade or more to field are technologically obsolete before IOC is achieved."[11] These critics advocate agile defense acquisitions based on commercial business practices and rapid development cycles. In short, the defense acquisition system must be more flexible, innovative, and responsive.

The issue is further exacerbated by political control of the defense acquisition process. The acquisition system is ultimately a political process. It struggles to be business-like and efficient in tension with "the Government's need to institute a management system that maintains public accountability and trust."[12] Congress is a major stakeholder; it will continue to exercise a strong oversight role and try to regulate the process to perfection based on its past record.[13] Since 1792, Congress has passed over 4,000 acquisition-related statutes and changes. Similarly, since 1971, the U.S. General Accounting Office (GAO) has issued over 900 reports on weapon systems acquisitions and on acquisition reform initiatives.[14] The defense acquisition system is firmly rooted in our system of government.[15] So political constraints contribute to the strategic difficulties of developing feasible and executable policy changes.

NEW DEFENSE ACQUISITION SYSTEM

The 2003 defense acquisition model, highlighted in Figure 1 below, represents the third significant restructure since 1991.[16] This change launches another generation of change in a long line of policy changes. The system has been tinkered with over the past 50 years. The main objective of this new model is to shorten the acquisition cycle time.

Although the milestone review structure (acquisition phases and milestone decision reviews) has changed considerably, its original framework has survived since Deputy Secretary

of Defense David Packard first established it in May 1969.[17] Both the commercial and defense industries use a milestone decision review process which is based on the "idea that the acquisition cycle should be broken up into phases and that progress from one phase to the next should not be automatic."[18] A program is thus moved to the next phase only if it has successfully completed the previous phase. Conceptually, the key difference in the 2003 model is the determination of when a formal program is initiated.

Today, programs are initiated much later in the process (Milestone B), rather than up front. Thus the process is designed to reduce the risks associated with immature technologies and to eliminate non-viable alternatives earlier. However, "the delay in [declaring program start appears] to shorten cycle time if [technology] development and production timelines remain unchanged."[19] The number of acquisition phases and in-progress decision reviews has increased substantially, indicating a reversion to a more centralized control process.[20] Since the 1980s, acquisition policies and control have oscillated between centralized and decentralized program management. As the complexity and unpredictability of the system increases, typical hierarchical management control strategies become less effective.[21] This raises considerable concern over the effectiveness of current system changes.

From 1996 – 2002, GAO repeatedly identified significant cost overruns and schedule slips in many weapon system programs. GAO recommended a number of acquisition reforms which have directly influenced or shaped the current model and process, including recommendations to separate technology from product development (mature technology to reduce risk and improve system outcomes) and moving to a "knowledge-based approach" which enables program managers to "learn about the design capabilities to satisfy requirements and a prototype's ability to be manufactured earlier in the process." [22]
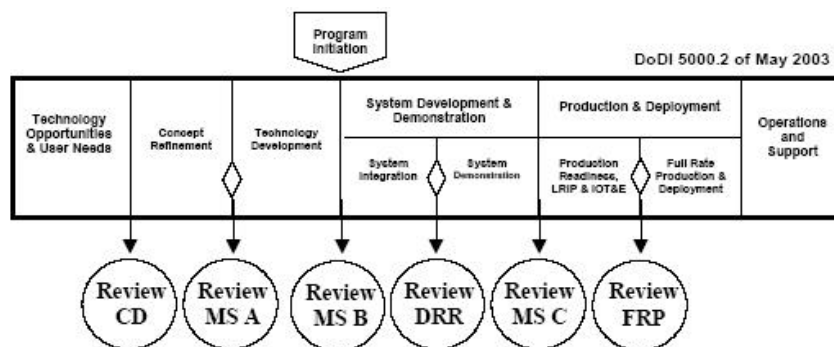
FIGURE 1: DEFENSE ACQUISITION MANAGEMENT FRAMEWORK.[23]

POLICY SHIFT TO AN EVOLUTIONARY ACQUISITION STRATEGY

In a key policy change, DOD decided to use evolutionary acquisition as the preferred approach for acquiring weapon systems.[24] Evolutionary acquisition is not new. This approach "fields an initial operationally useful and supportable capability in as short a time as possible" with the explicit intent to deliver or field improved capability in the future.[25] However, fiscal constraints and budget turmoil raise serious concerns about the long-term investment inherent in this approach. The concept has been debated for at least 20 years. Evolutionary acquisition "stresses an incremental approach to development, which capitalizes on the best mature technologies available at a given point in time."[26] It thus takes advantage of concurrent engineering and reduces cycle time by minimizing technical uncertainty at the start of a formal program. Minimizing technological uncertainty may reduce product development cycle time, but it does not necessarily reduce technology development cycle time.

Evolutionary acquisition represents a major shift from the "old single-step-to-full-capability model (grand design approach) that dominated previous acquisitions for the past 30 years. It has never been implemented on a wholesale basis or across all major weapon system programs within DOD."[27] In fact, evolutionary acquisitions may proceed in two discrete ways: incremental development and spiral development. Incremental development is "an acquisition strategy of gradually improving a capability through a planned series of block upgrades [now called increments], and spiral development is a strategy for achieving a new capability through the phased development of fieldable prototypes."[28] But will this dual evolutionary acquisition approach speed up the development cycle time and field an operationally effective and suitable capability faster?

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EFFECTIVENESS OF PAST POLICY CHANGES TO REDUCE CYCLE TIME

POLICY FORMULATION AND APPROACHES

A number of acquisition policy changes, dating back as early as 1969, have been designed to reduce cycle time. These changes rely on two major methods typically used for formulating acquisition policy: the "rational-comprehensive" approach or the "successive limited comparisons" approach.[29] The first approach enacts a strategy that best fits available means (resources) and ends (goals); the second approach "muddles through" to produce a policy derived from collective agreement without regard to the best match between means and ends.[30] Since 1991, acquisition policy changes reflect the latter approach. Historically, policy changes have varied between the two methods with mixed and debatable results.

KEY CHANGES FROM THE 1970s

In 1979, the RAND Corporation evaluated the effectiveness of "the second generation of acquisition policies" initiated by Secretary Packard from 1969 – 1971.[31] Secretary Packard realized the underlying assumption of the 1960s was incorrect: development of systems is not a predictable activity but rather a "highly uncertain business requiring a cautious management style."[32] This reassessment arose from a growing concern about the length of time required for a system to move through the entire acquisition process. The goal then was "reasonably short acquisition intervals and fielded times to capitalize on lead times in technology."[33] Secretary Packard instituted a number of policy initiatives to reduce the length of time required to move a system through the process. He advocated (1) early hardware prototyping and testing, (2) increased competition in hardware developmental efforts (more than one developer in parallel), and (3) comprehensive independent testing of near-production quality hardware in Full-Scale Development (FSD), now called Systems Development and Demonstration (SDD).[34]

In the late 1970s, RAND found that competitive development programs provided a quality advantage (choice of designs), slightly better performance advantage, and substantially lower cost growth over noncompetitive developments. However, RAND also noted the growing problem of "longer acquisition intervals."[35] This finding was reinforced by the 1978 Defense Science Board (DSB) Study, entitled *The Acquisition Cycle*.[36] RAND and DSB identified two other factors that contributed to this growing problem. The first factor was the production cycle time—the back end of the process (time period from start of production to completion of fielding or achievement of full operational capability). They found that the problem was not development cycle time but rather protracted "production rates" or "slow fielding rates." The principal cause of stretching out production was funding instability and budget constraints.[37]

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The other factor that contributed to longer acquisition intervals was the pre-acquisition cycle time or front end (time period from conception to FSD, now SDD). RAND, DSB, and other studies determined that the front end process dramatically increased from two years in the 1950s to five years by the early 1970s, with the greatest increase during the 1960s (Figure 2). [38]

Figure B-1—Increase in Pre-FSD Development Times From the 1950s to the 1970s
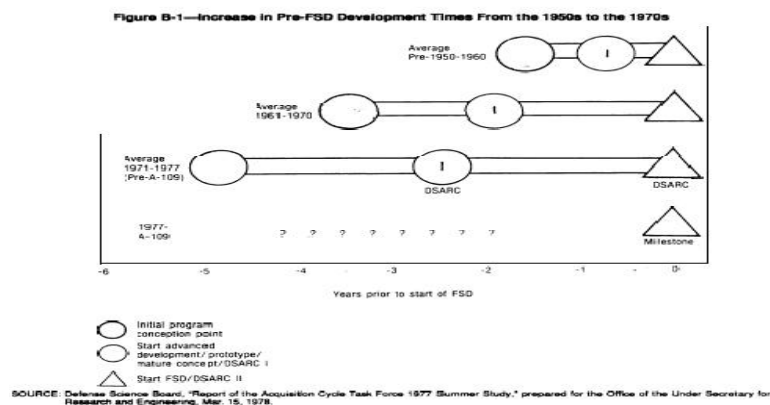
Figure 2: Comparison of Pre-FSD Cycle Times from the 1950 S to the 1970 S. [40]

In addition, these studies concluded that the FSD or SDD cycle time (product development) remained for the most part unchanged during this period, which contradicts claims by critics during this period. In summary, what increased significantly was the cycle time for the front end and back end. [39] These problems have befuddled all efforts aimed at reducing cycle time.

1980s CARRY OVER

Concurrent and competitive development from the late 1970s carried over into the 1980s, but parallel, competitive FSD development was never adopted across the board. DOD Directive 5000.1 was changed to encourage the services to use concurrent engineering in order to reduce development cycle time. [41] As in the 1970s, critics continue to argue that the "time it takes to design, develop, and produce weapon systems is not only excessive, but it continues to increase." [42] Most notably, this concern was highlighted in the 1986 Packard Commission Report: "The length of the acquisition cycle is a central problem from which most other acquisition problems stem." [43] The report concluded that lengthy cycle times generated new systems with obsolete technology by the time of fielding. A number of external factors caused this problem: legislative changes, technical difficulties, and funding instability. The report then

asserted that "removing these factors could reduce the average program cycle time by 11 percent."[44]

According to a 1982 Air Force Study, post-1970 acquisitions were dominated by problems of program instability. One of the root causes was funding instability. [45] In 1985, the DSB compared the defense acquisition process with those in the commercial sector. The only major difference cited was that the commercial sector placed greater importance on holding to schedule.[46] The pendulum swung back to encourage the use of concurrency. However, the controversial B1-B bomber program, a rapid development program entered into production three years before its developmental testing was completed, demonstrated that "an unduly short [development cycle] could result in immature technology being deployed, with associated loss of capability relative to expectations and with substantial modifications and maintenance costs." [47] In 1987, Congress changed the process. Programs could no longer go beyond Low-Rate Initial Production (LRIP) unless the Initial Operational Test and Evaluation (IOT&E) was completed.[48] Concurrent development can progress quickly and reduce cycle time, but it can also lead to programmatic complications and unpredictable schedules.

RE-INVENTION IN THE 1990s

The acquisition process changed considerably in 1996, when it adopted a number of Packard initiatives that were never fully adopted across the board, such as the use of concurrent engineering and competitive prototyping. In 1994 and 1995, Congress enacted The Federal Acquisition Streamlining Act (FASA) and the Federal Acquisition Reform Act (FARA). Both laws brought sweeping and needed changes to the procurement and systems acquisition processes. The laws also encouraged acquisition strategies to use commercial-off-the-shelf (COTS) technology and solutions.[49]

DOD also implemented the Cost as an Independent Variable (CAIV) policy, which "would attempt to move away from trying to achieve the best level of weapon system performance at almost any cost."[50] The end of the Cold War led to a significant decline in U.S. defense spending. But cycle time continued to be a topic of interest. DOD attempted to expedite the process by encouraging greater use of Advanced Concept Technology Demonstrations (ACTD) and Advanced Technology Demonstrations (ATD). These experimental tools generated a second parallel acquisition process, providing warfighters with the opportunity to assess prototype operational capability before formal program initiation. The intent was to bridge the gap and improve the transition path of Science and Technology (S&T) projects into the formal acquisition process.

As procurement funding steadily declined, DOD extended program productions or "fielding time" significantly. The most common practice was "to stretch out production schedules for years."[51] In NSIAD-97-23, GAO identified insufficient funding as the major contributing factor. Production plans on average stretched out eight years or longer from their original production schedules. For example, in 1997, the Black Hawk Helicopter program was stretched out an additional 43 years to complete production.[52] During this period, GAO determined that over 80 percent of all major acquisition programs had protracted production schedules.[53] This problem began in the late 1970s and is one of the root causes of why the acquisition process is regarded as dysfunctional.

In 1998, DOD started to track cycle time for major defense programs. Cycle time was approved as a measurement for tracking performance improvement under the Government Performance and Results Act (GPRA) of 1993.[54] DOD also established "a policy goal to deliver new systems to the field in 25 percent less time —less than 99 months—than programs initiated before 1992."[55] The 25 percent reduction goal was based on the historical average of 132 months. Based on the 2000 data in Figure 3, DOD is making progress in reducing cycle time for those programs that started after 1992. The 1992 average cycle time of 102 months is comparable to the benchmark times in the 1970s of seven years, which refutes loose claims by many recent critics regarding cycle time.

In 1999, the benchmark was changed to reduce the average cycle time by 50 percent—to 66 months. Results based on the 2000 data are displayed in Figure 3. They indicate a considerable reduction in cycle time for programs that started after 1998. However, the relatively small number of new programs raises considerable concern about future forecasts. A large number of current leap-ahead technology development programs are averaging cycle times greater than 130 months, raising more doubt and skepticism. Figure 4 compares defense and commercial cycle time reduction trends and forecasts. As in the commercial world, DOD is striving to cut its cycle time in half. But program managers and warfighters remain frustrated by long cycle times and inconsistent outcomes—the pendulum effect. As we have noted, there is no systematic approach to measure the "total acquisition cycle time." Neither pre-acquisition nor production cycle time is systematically considered. DOD cannot focus solely on the development cycle time without consideration of the front end or back end. Both ends are getting longer, provoking more questions about the effectiveness of the recent overarching policy changes.
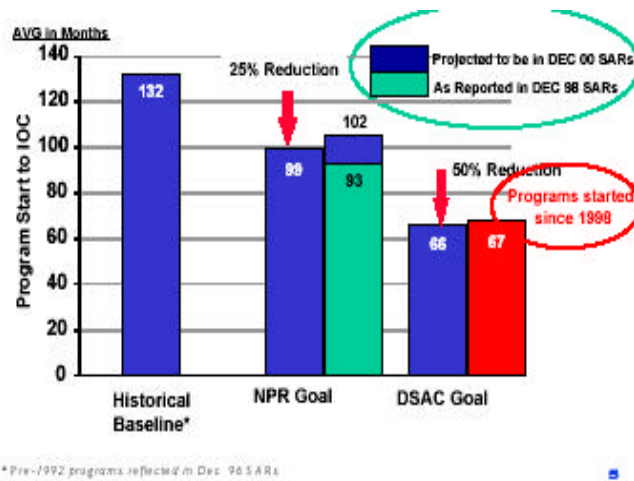
FIGURE 3: MAJOR DEFENSE ACQUISITION PROGRAM CYCLE TIME.[56]

Cycle Time Benchmarks

Industry	Past	Current	Goal
Defense	132 months	102 months	< 66 months
Automobile	84 months	24 months	< 18 months
Commercial Aircraft	96 -120 months	70 months	30 months
Commercial Spacecraft	96 months	18 months	12 months
Consumer Electronics	24 months	6 months	< 6 months

FIGURE 4: COMPARISON OF CYCLE TIME BENCHMARKS.[57]

CURRENT CHALLENGES WITH CYCLE TIME REDUCTION

MANAGEMENT OF TECHNICAL RISK

Technical issues, funding, and COTS management continue to challenge our current acquisition process and environment. As DOD shifts from an old single-step strategy to an evolutionary acquisition approach, efforts to accelerate product development (SDD) and reduce

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cycle time cannot proceed blindly. Rapid product development works best with mature technology. As GAO found in GAO-99-162, the commercial market matures new technology before it is included in products. This management practice is the main determinant of success for launching new products.[58] However, DOD's practice differs significantly from this commercial best practice: DOD attempts to save time by overlapping and compressing technology development and SDD as is evident in the Unmanned Combat Air Vehicle (UCAV) program (Figure 5).
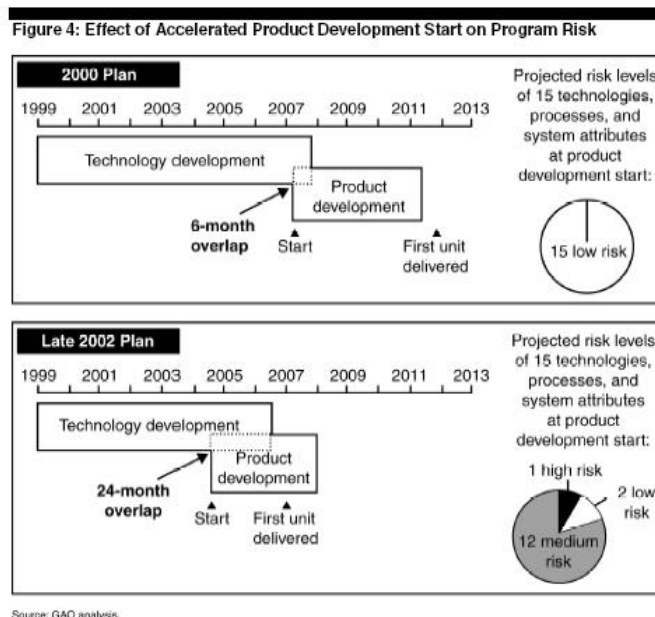
FIGURE 5: THE EFFECT OF OVERLAPPING TECHNOLOGY AND PRODUCT DEVELOPMENT.[59]

Evolutionary acquisitions require greater emphasis on technological maturity and on managing tighter development schedules. There is a causal relationship between maturity of technology and schedule compression. Hurried programs increase uncertainty, with greater chances for program baseline breaches and less performance predictability.[60] Commercial industry tries to avoid these problems by separating technology development from product development. The commercial market transitions new technologies much later and at a higher technology readiness (TRL) or maturity level than does DOD. Typically, the commercial world will transition technology at TRL 7 or 8, while DOD tends to transition technology sooner, at TRL 5 or 6.[61]

Although commercial and defense users perform in different operating conditions, the common denominator for success ultimately depends heavily upon the maturity of technology. The key is to find the right level of acceptable risk and point of transition, as illustrated in Figure 6 below. Although the commercial market has rapidly reduced product cycle time, it has not necessarily reduced technology development cycle time. For example, the auto industry reduced its product development cycle time from 7 to 2 years, but at the same time, Ford took up to 10 years to develop and mature new voice-activated control technology before introducing it in the 1999 Jaguar.[62]

If DOD is going to reduce its cycle time, then it must properly leverage this approach by acknowledging the dilemma caused by the efforts to keep on schedule while taking full advantage of emerging technology. It can be argued that "time saved in a shorter [product development] phase (SDD) can only result from more time spent in the preceding phases of Concept Refinement and Technology Development with uncertainty of any genuine program cycle time reduction."[63] DOD's fundamental problem is that it blends these two distinct development activities, thinking it is producing a harmonious effect and saving time. Urgency of need and complexity may justify the amalgam of these activities, but two other conditions influence the outcome: the pressure of providing greater performance capabilities sooner (jeopardizing cost and schedule performance objectives) and the lack of adequate S&T funding to properly mature technologies.[64]
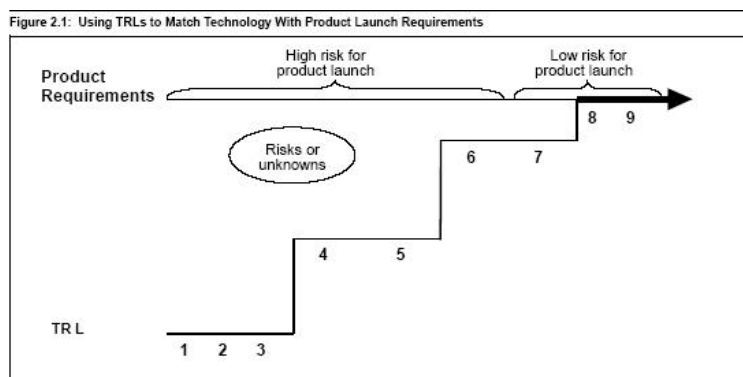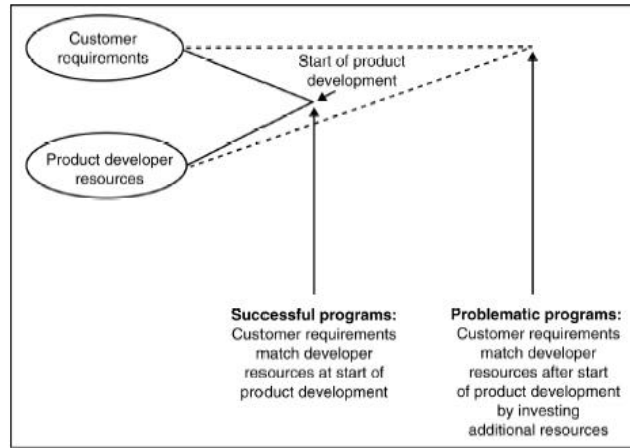

FIGURE 6: BALANCING TECHNOLOGY MATURITY AND RISK.[65]

DOD has a number of evolutionary acquisition developments ongoing that are falling short of expectations and are failing to realize the intended benefits of this approach. These

programs include the Air Force's UCAV, Airborne Laser, and Space Based Infrared High (SBIR) systems as well as the Army's Future Combat System (FCS). The common issue in these programs is the effort to integrate immature component technologies with matured technologies in overlapped and compressed SDD development paths. For example, FCS seeks to use 22 out of 31 technologies ranging between TRL 5 and 6.[66] The UCAV program has 15 technologies in similar classification.[67] Each of these evolutionary acquisitions is encountering significant problems. According to current studies, favorable results are unlikely. So the most likely outcomes are longer development cycle times and significant cost overruns and schedule delays.

Another related issue has potentially compounded the length of the DOD development cycle—the gap between resources and requirements at the start of SDD.[68] As illustrated in Figure 7 below, "it is rare for a program to proceed with a gap between product requirements and the maturity of key technologies and still be delivered on time and within costs."[69] DOD erroneously assumes this gap can be successfully closed in an accelerated development; but later it discovers the difficulty and the effects on cost and schedule caused by higher risks associated with immature technologies. Past studies have shown that when DOD enters product development or SDD with a significant gap in technology maturity, the gap leads to cost growth and schedule slips.[70] The greater the overlap between technology and product development, the greater the chances are for unmanageable risks and program baseline breaches as well as for longer cycle times.

Figure 3: Timing of the Match between Customer Requirements and Resources

Customer requirements

Start of product development

Product developer resources

Successful programs: Customer requirements match developer resources at start of product development

Problematic programs: Customer requirements match developer resources after start of product development by investing additional resources

Source: GAO.

FIGURE 7: MATCHING RESOURCES AND REQUIREMENTS AT THE START OF SDD.[71]

MANAGEMENT OF FUNDING AND REQUIREMENTS EXPECTATION

Funding and managing requirements expectations pose another serious problem. Since the late 1970s, funding instability has been a major source of turmoil. Today, many programs are adhering to an evolutionary acquisition approach, yet at the same time they are also competing in parallel for limited investment funds, all the while trying to provide initial capability sooner.   The escalatory gap between resources and requirements prior to start of SDD raises much concern. The push to deliver sooner is compressing the time during which technologies can be matured and integrated into the system.

Real concerns nonetheless surface whether or not sufficient resources can be provided to preserve the integrity of evolutionary acquisition. Likewise, we must manage requirement expectations or the strategy will fail. The strategy does not work unless the user can accept a 75 or 80 percent initial capabilities' solution up front. Further, the user cannot exercise false comparisons, such as comparing the performance of an initial capability increment with that of the older system earmarked for replacement. Similarly, the user cannot have unrealistic expectations.[72] In effect, the user cannot afford to front load his requirements in an initial capability increment to the point where it runs counter to strategy. There is no magical formula to determine a reasonable percent of capability. If 90 percent of system requirements are programmed into the first increment, then clearly an evolutionary acquisition strategy is

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inappropriate. DOD cannot afford "the old attitude of hedging its bet" because the consequence is a failed acquisition strategy. [73]

As stated earlier, evolutionary acquisition increases the risk of cost growth and schedule delays.[74] Affordability concerns are compounded by the fact that in the last decade DOD has routinely migrated investment or modernization funds to pay for readiness or other higher priority bills. Many of these key evolutionary acquisitions will dominate the Services' investment accounts, creating major concerns about sustained funding. DOD has to change its modernization strategy. There must be a balance between limited means (resources) and the desired ends (current force needs and future capabilities). A fundamental mismatch exists between defense policy and the acquisition strategy. DOD cannot assume "absent future budgetary pressures in the short-term" or assume full recovery of decrements made to investment accounts over the past decade.[75] DOD has a massive aging problem with its defense capital stock or equipment (current inventory of weapon systems). The estimated value of DOD's current equipment is $1.9 trillion.[76]

There will be tremendous pressure in the Future Years Defense Program (FYDP) to acquire new replacement systems, since a large portion of the defense capital stock will have deteriorated beyond the point that it can be effectively upgraded or remanufactured. It is appropriate to hedge for the future, but it is equally important to protect our current posture.[77] The major challenge is to adopt a new, comprehensive modernization strategy that strikes a policy balance through use of evolutionary acquisition strategies and realistic assessment of the resource needs of current forces and the future capabilities of next-generation systems. The acquisition strategy must match with available resources.

MANAGEMENT OF COTS

The final challenge is "managing the expectations for the benefits of using COTS products."[78] There are a number of myths and misplaced expectations about the use of COTS. DOD is now acquiring major and complex software-intensive systems. The common belief is that COTS functionality and solutions yield cost savings and quicker fielding of systems. However, "there is little compelling evidence that using COTS [software applications] is guaranteed to save money."[79] Indeed, "no universal software architecture exists that is suitable for all systems or to which all COTS products subscribe."[80] COTS must be incorporated according to the rules for developing the system. The truth is that "[the high-tech] features and functionality that make our systems unique (ready for military use) cannot be bought readily in the commercial marketplace."[81] Nevertheless, our acquisition system places a high degree of

confidence in using COTS to support evolutionary acquisitions. The problem is there is greater uncertainty because our development cycle time varies greatly from those in the commercial marketplace.[82]

In the 1980s, "there was growing interest in exploiting commercially developed technologies for defense applications."[83] Much of DOD incorporated a mix of grades and types of commercial parts and functionality to achieve desired performance capabilities at minimal costs, but the problem is that "military electronics is increasingly affected by out-of-production parts (diminishing manufacturing sources) due to short life cycles and the rapid turnover of commercial electronics technology."[84] Obsolescence is a problem both in development (because of rapid turnover) but also in supporting a system that has average service life of greater than 30 years. There has been an underlying assumption that DOD would keep pace with this rapid turnover by continuously funding technology insertion. However, budget cuts in the late 1990s have demonstrated the opposite holds true.[85] The demand for COTS will not go away, but we have to develop better policies and strategies to deal with the rapid turnover of the commercial electronics technology. We also need to improve systems engineering and testing to ensure that COTS integration and interoperability can be achieved where COTS is used. [86]

RECOMMENDATIONS TO HELP REDUCE CYCLE TIME

Reducing cycle time is important, but it is not a simple problem to fix. And it is not the only acquisition requirement DOD must address. It is a complex problem. If the problem is so simple, then why has DOD conducted over 128 acquisition reform studies?[87] There are three important recommendations to consider: (1) improve cycle time measures, (2) control resource and requirements expectations, and (3) develop a new modernization strategy.

BETTER CYCLE TIME MEASURE

Past policies aimed at reducing cycle time focused on improving and measuring the main development phase—SDD. If we are going to eliminate perceptions of a dysfunctional acquisition system, then we must expand the definition to measure the total acquisition cycle time, including the pre-acquisition cycle time (period from concept refinement to technology development) and the production cycle time (period from start to completion of production). As we implement new policies, DOD cannot afford to allow the front end to increase by 50 to 80 percent (from 5 to 8 years), as it did between 1950 and 1970.[88] There must be a constraint or control mechanism.

Several studies since the late 1970s have concluded that stretching out production is a serious problem. No major program can be managed with a high degree of efficiency in the

face of unpredictable changes or insufficient funding.[89] Stretching out production for years is an unacceptable trade-off in order to achieve limited but better system performance and capability in the short-term. As DOD shifts to evolutionary acquisitions, a more comprehensive cycle time measure is needed in order to better gauge the effectiveness of acquisition policies or their respective changes. DOD should approve and incorporate a new definition of total acquisition cycle time into the DOD Directive 5000.1: the cumulative period of time that a program proceeds through starting with the pre-acquisition cycle time (CTD), then the SDD development cycle time, and finishing with the production cycle time (production start to FOC).

The effectiveness of using evolutionary acquisitions (EA) with weapon systems is unproven. In view of major investments by the Services and growing interest in its use, benchmarks need to be established for judging the effectiveness of this acquisition strategy. DOD continues to muddle the distinction between technology and product development. Speed achieved through overlapping development creates significant risks and programmatic complications. The key is to recognize that "technology has a vote."[90] EA reduces predictability of schedule and cost. Given the dollars invested, it is essential to measure the effectiveness of this approach, starting now. We must determine whether it is viable—and at what cost.

CONTROL RESOURCE AND REQUIREMENTS EXPECTATIONS

Resource and requirements expectations must be controlled; otherwise, evolutionary acquisitions will foster inflexibility and unresponsiveness, rather than flexibility and responsiveness. DOD must avoid further muddling of the distinct activities of technology and product development (SDD). DOD must modify its practice and allow only mature new technologies to go forward, especially when speed and compression are essential. "This is an important piece of the puzzle for cycle time reduction."[91] Can DOD control user expectation and manage a program from 80 percent increment to 100 percent capability with overlapping developments, as depicted in Figure 8 below?
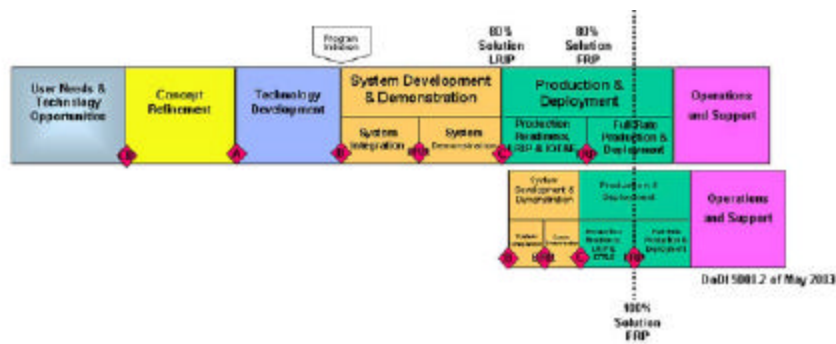
FIGURE 8: DEVELOPING INCREMENTAL SOLUTION SETS.[92]

DOD has ignored industry's success with this approach: Industry substitutes a different technology or develops an alternative approach to meet the user's requirements, instead of assuming that this gap between technology maturity and requirements can be closed in the middle of development without resource or schedule implications.[93] DOD must avoid adding greater performance capability too early and increase requirements to the point that such modifications negate the benefits of evolutionary acquisition strategies. Better safeguards are needed. In light of this analysis, is TRL 5 or 6 truly an acceptable level of technology readiness to justify an accelerated development?

Also, DOD must have better expectations and strategies regarding more effective use of COTS. COTS' functionality is not cheap or free from systems integration and testing challenges. COTS should not drive the acquisition of a complex system; use of COTS must be carefully evaluated and be truly supportive of integration without undermining the system acquisition approach. Given the rapid turnover of commercial electronics technology, DOD must develop a better way to provide concurrent funding to preclude obsolescence during development and during post-fielding or sustainment. This is an important issue in reducing cycle time.[94] DOD's equipment service life of 20 to 30 years far exceeds any comparable benchmark in the commercial industry. DOD must rethink investment options and seek Congressional support of the best practices.

IMPLEMENT A NEW ACQUISITION STRATEGY TO MODERNIZE

Given the shift to and emphasis on evolutionary acquisitions, DOD must improve its investment or modernization strategy because there is a fundamental mismatch between policy emphasis and resource demands. During the past decade, DOD has diverted "future weapon system procurements, even upgrades, to pay for rising operations and support costs."[95] Given

the Global War on Terrorism and the revolving door of competing requirements, DOD must rethink and revise its overarching acquisition strategy because it is not attainable or affordable.

DOD needs replacement systems now, not later. DOD does not have a plan to overcome the funding deficiencies that plagued DOD throughout the 1990s.[96] A new strategy is needed—a scalable, capital stock procurement strategy. In other words, some equipment or capital stock items (non-complex) should be acquired through COTS-based approaches in their entirety up front. These means "buy in-bulk" and buy within the FYDP or slightly beyond (no more than 8 years).[97] Unrealistic production cycle or fielding times that are measured over multiple decades are no longer acceptable. As research has shown, eliminating protracted fielding times is part of solving the "cycle time riddle."[98] This hidden problem reveals a major disconnect in a dysfunctional system.

We need a scalable strategy. Complex systems and other future capabilities that follow an evolutionary path need a different investment approach. These systems should be developed through "limited objective quantity buys" based on their evolutionary paths. This is called "wildcatting," the strategy of buying into a defense capital stock with smaller quantities for limited purposes, but with meaningful operational capability in order to hedge for the future and make room for future opportunities and new capabilities without locking into a given system or capability. [99]

CONCLUSION

Every knowledgeable analyst agrees that the acquisition cycle time is too long. Although Secretary Rumsfeld has made it a top DOD priority, it is not a transformational imperative but rather one piece of the puzzle. Repeated misguided policy changes to reduce cycle time have not been based on root cause analysis or holistic understanding. Many critics argue that the current cycle time is 15 – 20 years.[100] In truth, the historical average cycle time is 11 years, and the current time cycle (1998 and beyond) for new programs is 5 to 6 years. Although these more accurate statistics are more favorable, they do not eliminate this real problem. The current working definition of cycle time is too restricted—disingenuous. It focuses on measuring SDD development time and not the total acquisition time. A better measure is needed that encompasses the pre-acquisition cycle time and the production cycle time, which has the cumulative effect of adding decades. Future policy changes have to acknowledge the full problem.

Cycle time reduction is not a new problem, but older than 30 years. The acquisition system is both political and complex. The acquisition system has been restructured three times

since 1991. It is understandable that the acquisition system is viewed as dysfunctional, but changing the process every four years without fundamentally addressing other key problems and unintended consequences from past policy changes only creates greater dysfunction. Adoption of evolutionary acquisition as the preferred strategy is a risky step; a number of serious issues and challenges have to be addressed in order to prevent this strategy from failing.

"If indeed, shorter cycles are [going to be] facilitated by evolutionary acquisition, then better and more skillful programming and budgeting will be required."[101] This means adopting a new and scalable modernization strategy. It also means that we must find a better way to fund COTS-based concurrent development to better cope with the challenges of obsolescence and rapid turnover in commercial electronics technology. It means striking a capital stock investment balance between limited objective quantity buys and large quantity buys; it also means striking a better balance between current and future needs in shorter time spans. It means controlling the resource and requirements gap as we proceed with evolutionary acquisitions. DOD has to avoid the tendency to shove requirements up front; it must also stop muddling the distinction between technology and product development. Technology does have a vote. Evolutionary acquisition is not without risks. Speed achieved through overlapping concurrent developments can reduce cycle time, but only if the new technologies are truly mature enough when SDD starts. The acquisition system is not a hopeless system imprisoned by time and complexity. Real opportunities are available to shorten the acquisition cycle time.

WORD COUNT= 5,999

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ENDNOTES

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[3] Frank Wolf, "Rumsfeld Favors New Acquisition Strategy to Cut Fielding Time," Defense Daily 209, no. 8 (12 January 2001); [database on-line]; available from ProQuest; accessed 15 September 2003.

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[9] Birkler, 1.

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[12] LTC Stephen V. Reeves, *The Ghosts of Acquisition Reform: Past, Present, and Future*, Executive Research Project (Fort McNair: The Industrial College of the Armed Forces, April 1996), 10.

[13] David L. Ahearn, Jr. *DOD Materiel Acquisition—High Level Problems Require High Level Cures*, Strategy Research Project (Carlisle Barracks: U.S. Army War College, 10 March 1991), ii.

[14] Reeves, 1-2.

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[16] COL (Ret) John T. Dillard, *Centralized Control of Defense Acquisition Programs: A Comparative Review of the Framework from 1987 – 2003* (Monterey, CA: Naval Postgraduate School, 29 September 2003), 1.

[17] Theo Farrell, *Weapons Without A Cause: The Politics of Weapons Acquisition in the United States* (New York, N.Y.: St. Martin's Press Inc., 1997), 85.

[18] Ibid.

[19] Dillard, 47.

[20] Ibid, 38.

[21] Ibid, 12.

[22] Ibid, 7.

[23] Ibid, 38.

[24] Richard K Sylvester and Joseph A. Ferrara, "Conflict and Ambiguity: Implementing Evolutionary Acquisition," *Acquisition Review Quarterly* (Winter 2003): 5.

[25] Ibid, 5-6.

[26] Ibid, 8.

[27] Ibid, 10-11.

[28] Ibid, 14.

[29] Ibid, 21.

[30] Ibid, 21.

[31] Edmund Dews et al., *Acquisition Policy Effectiveness: Department of Defense Experience in the 1970s* (Santa Monica, CA: RAND, 1979), 1.

[32] Ibid.

[33] Ibid, 3.

[34] Ibid, 17-18.

[35] Ibid, *28* and 59.

[36] Ibid, *59.*

[37] Ibid, *72* and 76.

[38] Office *of* Technology Assessment, *Holding the Edge: Maintaining the Defense Technology Base* (Washington, D.C.: U.S. Government Printing Office, January 1990), Volume 2, Appendix B, 47.

[40] Ibid, 48.

[39] *Ibid.*

[41] *Congressional* Budget Office, *Concurrent Weapons Development and Production* (Washington, D.C.: Congressional Budget Office, August 1988), 24.

[42] *Jeffrey* A. Drezner, *An Analysis of Weapon System Acquisition Schedules* (Santa Monica, CA: RAND, 1997), v.

[43] Ibid, 1.

[44] Ibid, vii.

[45] Ibid, 3.

[46] Ibid, 4.

[47] Ibid, 43.

[48] *Congressional* Budget Office, 24.

[49] Valerie Bailey Grasso, *Defense Acquisition Reform: Status and Current Issues* (*Washington*, D.C.: Congressional Research Service, 8 November 2001), 4.

[50] Ibid, 6.

[51] U.S. General Accounting Office, *Weapons Acquisition: Better Use of Limited DOD Acquisition Funding Would Reduce Costs* (Washington, D.C.: U.S. General Accounting Office, February 1997), 3.

[52] Ibid, 3-4.

[53] Ibid, 4.

[54] Office of the Inspector General Department of Defense, 1.

[55] Ibid.

[56] John C. Wilson, "Acquisition Cycle Time Reduction," briefing slides, Defense Systems Affordability Council, 1 April 1999; available from http://www.acq-ref.navy.mil/reflib/0499dsac.pdf; Internet; accessed 7 November 2003, 5.

[57] "Cycle Time Benchmarks," briefing slides; available from http://www.neat.com/eash.pdf; Internet; accessed 7 November 2003.

[58] U.S. General Accounting Office, *Better Management of Technology Development Can Improve Weapon System Outcomes* (Washington, D.C.: U.S. General Accounting Office, July 1999), 2.

[59] U.S. *General* Accounting Office, *Matching Resources with Requirements Is Key to the Unmanned Combat Air Vehicle Program's Success* (Washington, D.C.: U.S. General Accounting Office, June 2003), 13.

[60] U.S. General Accounting Office, *Better Management of Technology Development Can Improve Weapon System Outcomes*, 17.

[61] Ibid, 4 and 7. *In* Appendix 6 of the Defense Acquisition Guidebook (formerly DOD 5000.2R), there is a matrix classification scheme to better understand the different levels. The following chart from GAO-99-162 provides a summary explanation:

Appendix I

Technology Readiness Levels and Their Definitions

Technology readiness level	Description
1. Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.
2. Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4. Component and/or breadboard validation in laboratory environment.	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.
5. Component and/or breadboard validation in relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.
6. System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in simulated operational environment.
7. System prototype demonstration in an operational environment.	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in an operational environment, such as in an aircraft, vehicle or space. Examples include testing the prototype in a test bed aircraft.
8. Actual system completed and "flight qualified" through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.
9. Actual system "flight proven" through successful mission operations.	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last "bug fixing" aspects of true system development. Examples include using the system under operational mission conditions.

[62] Ibid, 13-14.

[63] *Dillard*, 46.

[64] U.S. *General* Accounting Office, *Better Management of Technology Development Can Improve Weapon System Outcomes*, 5-6.

[65] Ibid, 12-13.

[66] U.S. *General* Accounting Office, *Issues Facing the Army's Future Combat Systems Program* (Washington, D.C.: U.S. General Accounting Office, 13 August 2003), 25.

[67] U.S. *General* Accounting Office, *Matching Resources with Requirements is Key to the Unmanned Combat Air Vehicle Program's Success*, 11.

[68] Ibid, 3-4.

[69] Ibid, 3-4.

[70] U.S. *General* Accounting Office, *Better Management of Technology Development Can Improve Weapon System Outcomes*, 5.

[71] U.S. *General* Accounting Office, *Matching Resources with Requirements is Key to the Unmanned Combat Air Vehicle Program's Success*, 7.

[72] Col (Ret) *Wayne* M. Johnson and Carl O. Johnson, "The Promise and Perils of Spiral Acquisitions," *Acquisition Quarterly Review* (Summer 2002): 185.

[73] Sylvester, 19.

[74] U.S. *General* Accounting Office, *Issues Facing the Army's Future Combat Systems*, 3.

[75] *Steven* M. Kosiak, *Buying Tomorrow's Military: Options for Modernizing US Defense Capital Stock* (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2001), 11 and 42.

[76] Ibid, 9-12.

[77] Ibid, *42*.

[78] *Michele* Motsko et al., *Rules of Thumb for the Use of COTS Products* (Pittsburgh, PA: Carnegie Mellon University, December 2002), 1.

[79] Ibid, 4.

[80] Ibid, 1 and 2.

[81] Ibid, 3.

[82] Ibid, 19.

[83] Mark *Lorell* et al., *Cheaper, Faster, Better?* (Washington, D.C.: RAND, 2000), 1.

[84] Ibid, 84-85.

[85] Ibid, 80-*85*.

[86] Major *Holly* R. Mangum, "You Don't Need to Test COTS Components and Other Myths," *Program Manager* (March-April 2002): 58.

[87] *Elizabeth* G. Book, "Washington Pulse," *National Defense* (January 2002); available from http://www.nationaldefensemagazine.org/article.cfm?id=693; Internet; accessed 5 November 2003.

[88] Office *of* Technology Assessment, 49.

[89] Dews, 78.

[90] Richard D. Hansen, Jr., *Competition: A Means to Transform the Defense Industrial Base*, Strategy Research Project (Carlisle Barracks: U.S. Army War College, 7 April 2003), 2.

[91] Collie J. Johnson, "Reducing Acquisition Cycle Time," 10.

[92] Dillard, 49.

[93] U.S. *General* Accounting Office, *Better Management of Technology Development Can Improve Weapon System Outcomes*, 3.

[94] Ibid, *17*-18.

[95] *Thomas* A. Atkinson, *Skipping a Generation of Weapons System Technology* (Monterey, CA: Naval Postgraduate School, March 2003), 50-51.

[96] Ibid, 49.

[97] Motsko, 19.

[98] *Griffard*, 1.

[99] *Kosiak*, 40-49.

[100] *Griffard*, 1.

[101] Dillard, 51.

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